Hoffer Intelligent Transmitter

Model: HIT-1B

USER'S MANUAL

HP-297
October 2005

HOFFER FLOW CONTROLS, INC.
The Turbine Flowmeter Company

107 Kitty Hawk Lane, P.O. Box 2145, Elizabeth City, NC 27906-2145
800-628-4584 252-331-1997 FAX 252-331-2886
www.hofferflow.com E-mail: info@hofferflow.com

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During installation, care must be taken to select the correct interconnecting wiring drawing. The choice of an incorrect connection drawing may result in damage to the system and/or one of the components.

Please review the complete model number of each item to be connected and locate the appropriate manual(s) and/or drawing(s). Identify all model numbers exactly before making any connections. A number of options and accessories may be added to the main instrument, which are not shown on the basic user wiring. Consult the appropriate option or accessory user manual before connecting it to the system. In many cases, a system wiring drawing is available and may be requested from Hoffer Flow Controls.

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1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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1. INTRODUCTION

The HIT-1 (Hoffer Intelligent Transmitter) is a loop powered intelligent flow rate transmitter. The transmitter is compatible with all Hoffer turbine flowmeters and the H.O.G. series positive displacement flowmeters.

The transmitter can accept a low level frequency signal, a pulse signal, or a contact closure on the input and provides a linearized 4-20 mA current output which is proportional to the flow rate.

The HIT-1 is fully configurable with K-factors, frequencies, and timebase being configured via the RS232 communications port. The configuration and monitoring can be performed using any PC based communications program (e.g., HyperTerminal) or ASCII terminal.

The transmitter is housed in an aluminum enclosure and can be mounted directly on a flowmeter or wall mounted using an optional NEMA 4X or EX enclosure. An optional DIN rail mounting bracket is also available for mounting on a standard DIN rail.

This transmitter is designed to conform to the EMC-Directive of the Council of European Communities 89/336/EEC and the following standards:

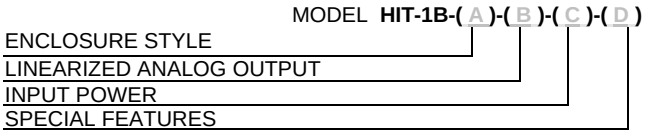
Generic Emission Standard EN 50081-1
Residential, Commercial & Light Industry Environment.

Generic Emission Standard EN 50081-2
Industrial Environment.

Generic Immunity Standard EN 50082-1
Residential, Commercial & Light Industry Environment.

Generic Immunity Standard EN 50082-2
Industrial Environment.

1-1 Model Number Designation



ENCLOSURE STYLE
MODEL **HIT-1B-(A)-( )-( )-( )**
OPTION (A)

(1)	GENERAL PURPOSE. 2.6"L X 2.6"H X 2.6"W MINIMUM MOUNTING SPACE.
(D)	2" LONG DIN RAIL MOUNT SINGLE UNIT. UP TO 20 HIT-1B UNITS CAN BE MOUNTED ON A SINGLE RAIL. ADD 2" PER UNIT.
(3/O)	MEETS CLASS 1, DIV. 1 AND 2, GROUPS C, D CLASS II, GROUPS E, F, G NEMA 4X WITH 'O' RING CERTIFIED CSA, UL BODY KILARK #GECCT-3, STOCK #200-0945 FLAT COVER, STOCK #200-0533, KILARK GECBC
(3B/O)	MEETS CLASS I, DIV. 1 AND 2, GROUPS A, B, C, D CLASS 1, ZONES 1 AND 2, GROUPS IIB + H2, IIA CLASS II, DIV. 1 AND 2, GROUPS E, F, G CLASS III, NEMA 3, 4, 7 (B, C, D), 9 (E, F, G) CERTIFIED CENELEC, CSA, UL, FM BODY KILARK #HKB, STOCK #200-0406 FLAT COVER, STOCK #200-0773, KILARK #HKB-B
(3B/O-ATEX)	MEETS CLASS I, DIV. 1 AND 2, GROUPS A, B, C, D CLASS 1, ZONES 1 AND 2, GROUPS IIB + H2, IIA CLASS II, DIV. 1 AND 2, GROUPS E, F, G CLASS III, NEMA 3, 4, 7 (B, C, D), 9 (E, F, G) CERTIFIED ATEX, CENELEC, CSA, UL, FM BODY/COVER STOCK #200-2006

LINEARIZED ANALOG OUTPUT
MODEL **HIT-1B-( )-(B)-( )-( )**
OPTION (B)

(7)	4 TO 20 MA UP TO 20 POINTS. ACCURACY +/-0.02% OF FULL SCALE.

INPUT POWER
MODEL **HIT-1B-( )-( )-(C)-( )**
OPTION (C)

(D)	8 TO 24 VDC LOOP POWERED.
(AC)	115/220 VAC 50/60 HZ EXTERNAL POWER. USE MODEL ACC39B

SPECIAL FEATURES
MODEL **HIT-1B-( )-( )-( )-(D)**
OPTION (D)

(CE)	CE MARK REQUIRED FOR EUROPE.
(SP)	ANY SPECIAL FEATURES THAT ARE NOT COVERED IN THE MODEL NUMBER USE A WRITTEN DESCRIPTION OF THE -SP.

2. SPECIFICATIONS

2-1 General

Input:	AC or DC signal 10 mV_{RMS} to 50 V_{RMS} (Magnetic coil, Pulse, Open Collector, Dry Contact).
Frequency Range:	0.2 to 3500 Hz.
DC power:	8 to 24 Vdc (loop powered)
Load Resistance:	650 O @ 24 Vdc
Output:	"Linearized" 4-20 mA proportional to flow rate. "Over-Range" capability: 24 mA.
Output Resolution:	16 bit, 0.2 µA
Accuracy:	±0.02% of full scale @ 20°C.
Temperature Drift:	40 ppm/°C.
Linearity:	±0.05% of full scale.
Update Time:	0.25 to 10 seconds.
Linearization:	Twenty point K-factor table.
Timebase:	Rate can be configured in units per second, minute, hour, or day.
Scale:	The 20mA point is configurable.
Communications:	RS232 for configuration and monitoring.

2-2 Physical

Temperature:	Operating: -40°C to 80°C.
Packaging:	General Purpose, Explosion proof, & DIN rail.
Dimensions for General Purpose:	1.47" (38 mm) wide x 2.55" (65 mm) long x 1.90" (49 mm) tall. mounting footprint 2.535" (65 mm) x 2.550" (65 mm).

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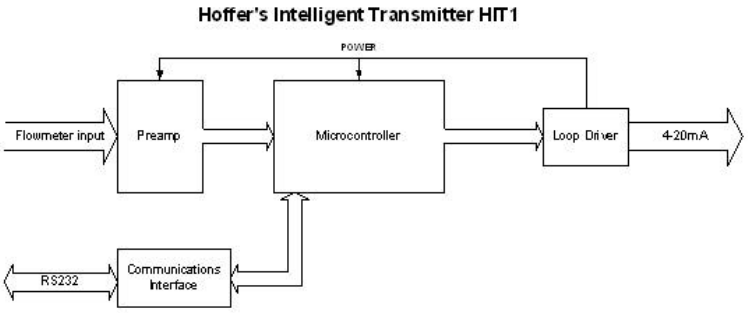
3. THEORY OF OPERATION

The HIT-1 consists of four functional blocks. These functional blocks are the Preamplifier, Microcontroller, Loop Driver, and Communications Interface.



3-1 Functional Blocks

3-1-1 Preamplifier

The Preamplifier accepts the input from the flowmeter. The Preamplifier applies amplification, low-pass filtering, and wave-shaping to the input signal. The wave shaping function converts the signal into a square-wave before sending it to the Microcontroller.

3-1-2 Microcontroller

The Microcontroller accepts the square-wave output of the preamplifier and performs all of the calculations that are required to control the Loop Driver. After measuring the frequency of the square-wave, the Microcontroller uses the following equations to compute the flow rate and current.

$$flowrate = \frac{frequency}{Kfactor} x60^{FM} xCF$$

Where:

Kfactor = Is dependent on the Flow Calculation Method setting and is either the Average K-Factor or the Linearized K-Factor from the Frequency / K-Factor table.

FM = Is the Flow rate Units setting of 0, 1, or 2. Where "0" is for Seconds, "1" is for Minutes, and "2" is for Hours.

CF = Is the Correction Factor setting.

$$current = 4mA + \left(16mAx \frac{flowrate}{AF} \right)$$

Where:

AF = Is the 20 mA maximum Flow rate value.

If the calculated flowrate is greater than the AF setting, the current will be set to 24mA to signal an "Over-range" condition. After calculating the current, the Microcontroller digitally sends the current information to the Loop Driver.

3-1-3 Loop Driver

The loop driver uses the digital information sent to it by the Microcontroller to set the current of the loop. The Loop Driver supplies power to both the Preamplifier and Microcontroller.

3-1-4 Communications Interface

The Communications Interface provides an RS232C port to the Microcontroller. The power for the Communication Interface is provided by the external terminal device. The Communications Interface is used to configure and trouble-shoot the transmitter.

3-2 System Response Time

The output current response time to flow rate changes depends on the frequency of the input signal. The response time varies from 0.25 seconds to the Maximum Sample Time(MST) setting. The MST setting is adjustable from 1 to 10 seconds. If the input frequency is greater then 4 Hz, the output is updated every 0.25 seconds regardless of the MST setting. When the flow rate drops to "0", the output drops to 4mA after the time set by MST. If the input frequency is less than 4 Hz, the output update time is equal to the period of the input signal (i.e., 1Hz ~ 1 second, 2Hz ~ 0.5 second…). The MST setting should be set to a number higher than the period of the lowest input frequency.

4. CONFIGURATION

The HIT-1 is configured using either a PC running Terminal Emulation software or a dumb ASCII terminal. The PC/terminal RS232C serial port configuration must be set as follows:

Baud rate:	2400
Data bits:	8
Parity:	none
Stop bits:	1
Handshaking:	none

The transmitter configuration is set and/or displayed by sending a series of character commands via the communications port to the unit.

There are two types of commands: READ and WRITE. READ commands (<***command***><CR>) upload data from the unit to the terminal and WRITE commands (<***command***>=<*value*><CR>) download data from the terminal to the unit. Each command is terminated with a Carriage Return (CR). If an invalid command is sent, the unit will respond with the message "Invalid Command!" or will return the complete command list. The complete command list is returned anytime a single Carriage Return (CR) character is sent to the unit.

The following sections discuss the various commands available for the HIT-1.

4-1 Configuration Commands

Command	*Description*
DN	**Tag Number**: User defined ID number. Maximum 999999.
AF	**20mA Maximum Flowrate**: Flow rate for 20mA output.
NB	**Maximum Sample Time**: This is the maximum time, in seconds, that the HIT-1 samples the input frequency before returning zero (Output = 4 mA). Default value = 1 second. Maximum value = 10 seconds. Recommend changing only for minimum input frequencies of less than 1.0 Hz.
CF	**Correction Factor**: User defined factor to multiply the flow rate calculation. Default value = 1.
FM	**Flowrate Units**: Sets the flow rate time units; '0' for SEC, '1' for MIN, '2' for HR, or '3' for DAY.
FC	**Flow Calculation Method**: Sets the flow rate calculation method to Average K-Factor or Linearization Table (Frequency vs K-Factor Table). Set to '0' for Average or '1' for Linearization.
AK	**Average K-Factor**: Set to the average K-factor from the meter calibration data. This value is used in the flow rate calculation when the FC command is set to "Average".
NP	**Number of Points**: Number of Frequency/K-factor pairs in the Linearization table. Maximum 20.
F##	**Frequencies 01-20**: Frequency values for the Linearization table. Maximum 20, Minimum number specified by **NP** command.
K##	**K-Factors 01-20**: K-factor values for the Linearization table. Maximum 20, Minimum number specified by **NP** command.

The following table lists the various configuration commands (both read and write) available for the HIT-1 transmitter along with the response from the HIT-1 for each command.

Description	***Read Command***	***Write Command***	***Response***
Tag Number	DN<CR>	DN=<value><CR>	TAG NUM = "value"
20mA Maximum Flowrate	AF<CR>	AF=<value><CR>	20 mA Flow = "value"
Max Sample Time	NB<CR>	NB=<value><CR>	MAX M TIME = "value"
Correction Factor	CF<CR>	CF=<value><CR>	CORR FACT = "value"
Flowrate Units	FM<CR>	FM=<value><CR> where value is 0, 1, 2, or 3.	FLOW UNITS = "value", Where value is SEC, MIN, HR, or DAY.
Flow Calculation Method	FC<CR>	FC=<value><CR> where value = 0 or 1.	F C METHOD = "value", Where value is AVG or LIN.
Average K-Factor	AK<CR>	AK=<value><CR>	AVG KFAC = "value"
Number of Points in Frequency vs K-Factor table	NP<CR>	NP=<value><CR>	NUM PTS = "value"
Frequency 1-20	F##<CR>	F##=<value><CR>	FREQ ## = "value"
K-Factor 1-20	K##<CR>	K##=<value><CR>	K-FACT ## = "value"

For example:

To set the maximum flow rate for the 20mA output to 821 gal/min:

Send from the terminal: *"AF=821<CR>"*
The HIT1 responds: *"20 mA Flow = 821"*
Send from the terminal: *"FM=1<CR>"*
The HIT1 responds: *"FLOW UNITS = MIN"*

4-2 Monitoring/Diagnostic Commands

Command	*Description*
DA	**Dump All:** Sends all the configuration settings to the attached terminal.
OM	**Output Maximum:** Sets the output current to 20mA. After one minute resets to the calculated output current.
OI	**Output Minimum:** Sets the output current to 4mA. After one minute resets to the calculated output current.
OF	**Output Frequency:** Sets the output current to the calculated current. (Default mode)
MO	**Medium Output:** Sets the output current to 12mA. After one minute resets to the calculated output current.
AA	**Continuous Display:** Continuously sends the calculated frequency and flow rate values to the attached terminal.

The following table lists the various monitoring/diagnostic commands available for the HIT-1 transmitter along with the response from the HIT-1 for each command.

Description	*Read Command*	*Response*
Continuously display Frequency and Flowrate	AA<CR>	FXXXXX.XX RXXXXX.XX
Dump Configuration	DA<CR>	Dump settings to terminal.
Set Output to maximum	OM<CR>	Output = 20 mA
Set Output to minimum	OI<CR>	Output = 4 mA
Set Output to Frequency scale	OF<CR>	Output = freq. scale
Set Output to 12 mA	MO<CR>	Output = 12 mA

To terminate or interrupt any Monitoring/Diagnostic command send another command other than the one currently in use.

4-3 Default Configuration

The HIT-1 is configured by the factory before shipment. If the unit is purchased with a Hoffer Flowmeter or if calibration data and configuration information is supplied, the unit is configured as appropriate. If the unit is shipped without specific configuration information, the unit is configured with the following default values:

FIELD	*Value*
DN	00000000
AF	500.00
NB	1.00
CF	1.00
FM	0
FC	0
AK	100.00
NP	20
F01	10.00
F02	50.00
F03	90.00
F04	100.00
F05	200.00
F06	300.00
F07	400.00
F08	500.00
F09	600.00
F10	700.00
F11	800.00
F12	900.00
F13	1000.0
F14	1100.0
F15	1200.0
F16	1300.0
F17	1400.0
F18	1500.0
F19	1600.0
F20	1700.0
K01	100.00
K02	100.00
K03	100.00
K04	100.00
K05	100.00
K06	100.00
K07	100.00
K08	100.00

FIELD	*Value*
K09	100.00
K10	100.00
K11	100.00
K12	100.00
K13	100.00
K14	100.00
K15	100.00
K16	100.00
K17	100.00
K18	100.00
K19	100.00
K20	100.00

5. INSTALLATION

The HIT-1B has an input conditioning circuit which accepts signals from most frequency or pulse producing flowmeters.

The input will interface directly to:

- Turbine Flowmeters
- Reed Switches
- Logic Signals
- Open Collector Outputs

The input is protected for over voltage up to 50 volts.

The signal conditioning circuit is configured for the selected signal type by appropriately setting the input selection DIP switches found on the HIT-1B signal input board (see following for switch settings). When interfacing with a MAG coil or dry contact (reed switch) signal the preamp input sensitivity is adjustable by setting the DIP switches S1-3 and S1-4 according to the following table:

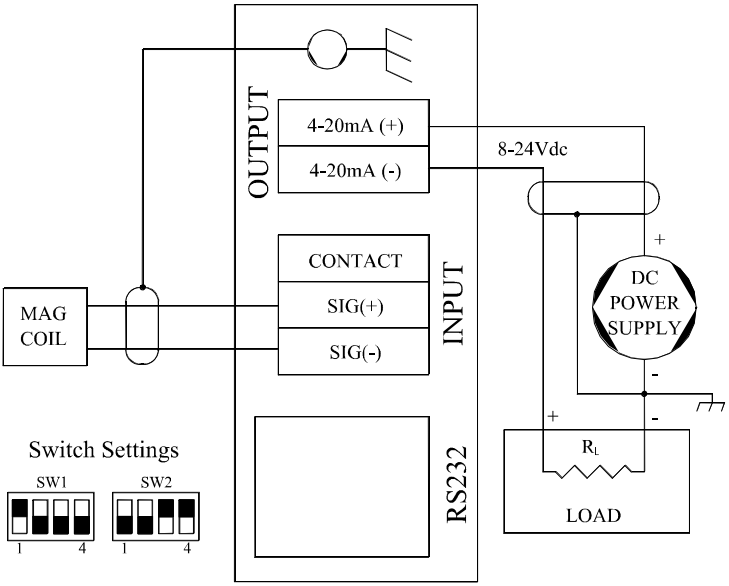
Sensitivity Level	S1-3	S1-4
$22mV_{p-p}$	off	off
$40mV_{p-p}$	on	off
$100mV_{p-p}$	off	on
$160mV_{p-p}$	on	on

The transmitters are shipped from the factory with the sensitivity set to the maximum setting ($22mV_{p-p}$) unless otherwise noted.

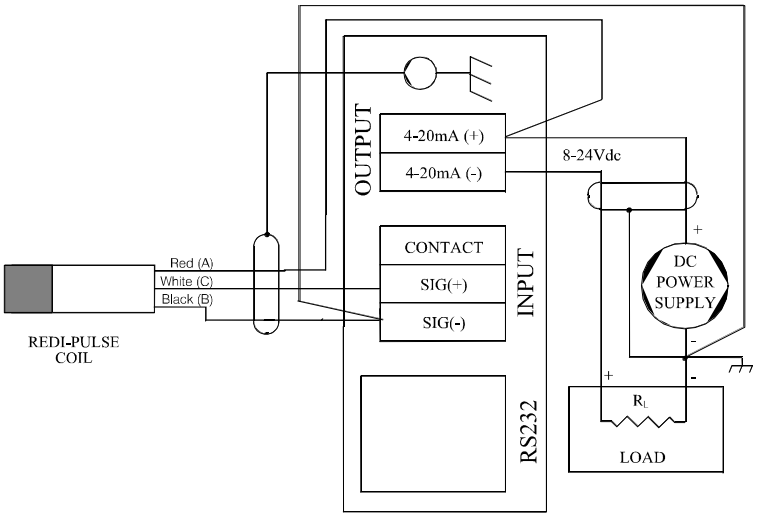
5-1 Typical Connections

The following figures illustrate the typical input and output connections for the various pickup types:

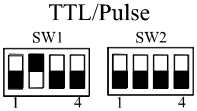
MAG Coil Input



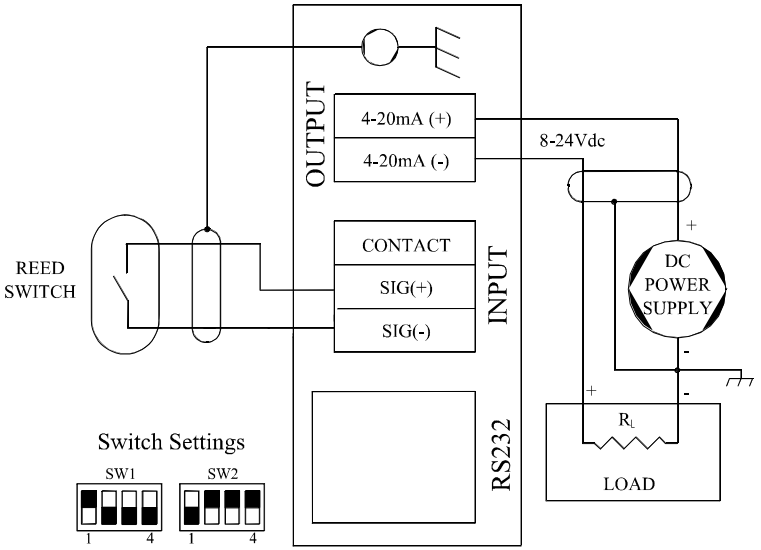
TTL Redi-Pulse Pick-up



Switch Settings:



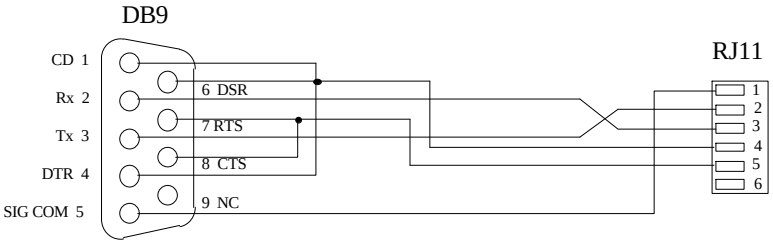
Reed Switch Input



5-2 Communications Connections

Communications with the HIT-1B using a terminal or a PC using the Windows configuration program requires the use of the HOFFER HIT-903 Communications Cable. The communication circuits of the HIT-1B are externally powered and the power for these circuits is supplied by the RS232 serial port of the computer/terminal. The serial port configuration must be set to the following:

Baud rate:	2400
Data bits:	8
Parity:	none
Stop bits:	1
Handshaking:	none



Hoffer HIT-903 Communications Cable

5-3 Wiring

When connecting the HIT-1, it is good practice to use shielded cable. The shield should be connected to earth ground near the instrument. The other end of the shield should not be connected.

In order to comply with the requirements for Electromagnetic Compatibility, as per EMC-Directive 89/336/EEC of the Council of European Community, this wiring practice is mandatory.